REMARKS

Claims 1, 4, 6 and 8-11 are presently pending in the application.

Claims 5 and 7 have been cancelled, and part of their subject matter inserted in independent claim 1 to claim the arrangement of a fuel cell stack with a plurality of unit cells and a plurality of unit humidifiers. Claim 1 has further been amended to more particularly claim the arrangement of the unit humidifiers in the total heat exchanger. The amendments to claim 1 are supported by previous claims 5 and 7 and the specification, particularly in Example 1 at pages 10-12 of the specification. Claims 4, 6 and 8-11 have merely been amended to conform to the preamble of claim 1. Accordingly, no new matter has been added by these amendments.

The Examiner has rejected claims 1 and 4-11 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,284,718 of Chow, et al., in view of JP 6-132038 ("JP '038"). The Examiner contends that Chow, et al., teach a fuel cell having an active section and a humidification section with the active section having unit cells with a first polymer electrolyte membrane and the humidification section having humidification units with a second polymer membrane. Regarding claims 7 and 9, now part of claim 1, the Examiner notes that a plurality of unit cells and a plurality of humidification units are disposed within the end plates of a fuel cell stack with the humidification units being installed between a current collector plate and the piston plate.

The Examiner acknowledges that Chow, et al., do not expressly teach an incoming gas being contacted with a discharged gas in the humidification units, as presently claimed. Instead, the humidification units of Chow, et al., function by transferring water from a liquid water stream across the membrane to an incoming reactant gas. The Examiner also acknowledges that Chow, et al., do no teach a second polymer membrane with a thickness less than 50 or 25 μm, as recited in claims 5 and 6, or that the piston plate is electrically insulating, as recited in claim 10.

However, the Examiner argues that JP '038 teaches a fuel cell stack in combination with total heat exchangers for concurrently moving heat and humidity from discharged gases toward the incoming fuel and oxidant gases. The Examiner concludes that the invention would have been obvious to one skilled in the art because the artisan would have been motivated by JP '038 to flow incoming and discharged gases through the humidification units of Chow to effect heat

and humidity exchange, since JP '038 teaches providing a stable amount of humidification in accordance with a change in the amount of reaction gas, the miniaturization and the capacity increase, and that this type of device does not require an external heat source or water but uses "easy steam humidification equipment."

The Examiner further contends that the thickness of the membranes is a result-effective variable and that Chow, et al., discussed the merits of a thinner membrane. Further, since the piston plate of Chow, et al., lies outside the area used to collect current from the active section, and electrically insulating member would be desirable to prevent electrical current from leaking from the end of the stack, so that it would have been obvious to make the piston plate electrically insulating.

This rejection is respectfully but strenuously traversed for the reasons set forth in detail below.

First, the humidification of Chow, et al., is quite different from that of the presently claimed invention. Thus, Chow, et al., are concerned solely with humidification of the fuel and oxidant gases. In contrast, the present invention is directed to the use of a total heat exchanger which means the transfer of both heat and humidity (water vapor) from one medium to another, namely between the gas discharged from the fuel cell and the gas supplied to the fuel cell (see the third full paragraph at page 4 of the present specification and the definition of "total heat exchange" at the fourth full paragraph of page 5 of the specification). This transfer of heat as well as humidity is important in the present invention, since when using a reformed gas as the fuel, the polymer electrolyte fuel cell is generally driven at a relatively high temperature around 70° C to 90° C (see first full paragraph of page 2 of the specification).

Further, since the fuel cell of JP '038 is also directed to total heat exchange of both heat and humidity, it would not be obvious to one skilled in the art to incorporate the total heat exchangers of JP '038 in the fuel cell stack of Chow, et al. Thus, whereas the fuel cell of the present invention and that of JP '038 both require high efficiency for both humidification and heat exchange, Chow, et al., do not show any recognition of the need of high efficiency for heat exchange, but are concerned solely with humidification.

Second, even if the teachings of Chow, et al., and JP '038 were properly combinable, the resulting combination would still not teach or suggest all of the features of the presently claimed invention. In particular, the present claims require that the unit humidifiers of the total heat

exchanger be alternatively laminated one-by-one with unit humidifiers for humidifying oxidant gas and unit humidifiers for humidifying fuel gas, with partitions between the alternating unit humidifiers, as described, for example, in the paragraph bridging pages 10 and 11 of the present specification. Such an arrangement of the unit humidifiers is neither shown nor suggested in Chow, et al., or JP '038. Instead, in Chow, et al., the oxidant humidification flow field plates 41 are located on the left hand side of the humidification section 30 in Fig. 1 and the fuel humidification flow field plates 42 are located on the right hand side of the humidification section 30, with the respective membranes 37 and 36 positioned between the flow field plates, respectively (see, col. 6, lines 10-23). That is, the fuel humidification units are grouped together at one end of the humidification section and the oxidant humidification units are grouped together at the other end of the humidification section.

Applicants have found this alternating arrangement of the fuel and oxidant humidification units to be particularly efficient for both humidification and heat exchange, and such an arrangement is neither taught nor rendered obvious by the cited prior art, either alone or in combination. Accordingly, for this reason also, the rejection is not applicable to the present claims and should be withdrawn.

Third, applicants dispute the Examiner's conclusion that the thickness of the membrane is merely a result-effective variable which would have been obvious to one skilled in the art based upon Chow, et al. As motivation for this modification, the Examiner points to col. 7, lines 1-20 of Chow, et al., which allegedly discusses the merits of a thinner membrane. However, the Examiner's reliance on this section of Chow, et al. is misplaced, since the membrane being referred to is the membrane of the fuel cell unit, and not the membrane of a total heat exchanger. Thus, Chow's motivation for a reduced thickness membrane is enhanced current density, which is irrelevant to a membrane being used in a heat exchanger or humidifier which do not involve considerations of current density.

Instead, according to the present invention, it has been found that a polymer electrolyte membrane in the total heat exchanger with the membrane not exceeding about 50 μm results in highly effective exchange of both heat and humidity. The thicker membrane of Chow, et al. is too thick to efficiently exchange both heat and humidity, and indeed Chow, et al. is only directed to humidification, as discussed above. Accordingly, the rejection is improper for this reason also and should be withdrawn.

As a final matter, applicants noticed an error in the Amendment filed with the RCE Request on October 31, 2003. Thus, in the Remarks section at page 5 of that Amendment, applicants referred several times to a prior art reference as "EP '357." That reference should have been "WO '357." While this should have been apparent from the record of this application, applicants wish to correct the record to make sure that it is clear. The error is regretted.

In view of the above amendments and remarks, it is submitted that all of the claims in the application patentably distinguish over the prior art and are in condition for allowance. Reconsideration and an early Notice of Allowance are respectfully solicited.

Respectfully submitted,

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